

DOCUMENT RESUME

ED 410 155

SO 027 802

AUTHOR Brand, Eva; Strauss, Sidney
TITLE Learning Strategies and Musical Organization in Children's Mental Model of Their Own Learning.
PUB DATE 97
NOTE 16p.; Paper presented at the Annual Meeting of the American Educational Research Association Convention (Chicago, IL, March 1997).
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Associative Learning; *Cognitive Development; Educational Research; Elementary Education; Higher Education; Learning Processes; Learning Readiness; *Learning Strategies; *Memorization; *Music Education

ABSTRACT

This paper describes the mental model children have of their own learning, derived from their behaviors when learning a song. The basic assumption of the study is that behavior is an outward expression of a psychological entity. The song chosen for the study was a complex, unfamiliar Zulu song. Thirty-six children in three age groups participated in the study of 6-, 9-, and 12-year-olds. Half of the children in each group also were learning to play a musical instrument. The children were tested individually and monitored by videotape and audiotape while learning the song. Results showed a significant developmental pattern with younger children being less accurate, and requiring more time to learn, and using more strategies in the process and fewer components of musical organization. Analysis of the data involved comparing the study results to the research on mental modeling. Charts and graphs are included in the main body of the paper and in the appendices. (EH)

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by
Eva Brand

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Published: 97

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LEARNING STRATEGIES AND MUSICAL ORGANIZATION IN CHILDREN'S MENTAL MODEL OF THEIR OWN LEARNING:

Eva Brand, Department of Musicology and School of Education,
Bar-Ilan University, Ramat Gan 52900, Israel

and Sidney Strauss, School of Education, Tel Aviv University,
Ramat Aviv 69978, Israel

evab@zoot.tau.ac.il
10 HaZayit Street, Kiron 55428, Israel

Aim

The purpose of this paper is to describe the mental model children have of their own learning, derived from their behaviors when learning a song. Such research belongs in the general field of "theories of mind" (Wellman, 1990), "theories in-action" (Argyris & Schon, 1974), and teachers' mental models of children's learning (Strauss, 1993).

Basic Assumption

The basic assumption of the study is that behavior is an outward expression of a psychological entity. It is possible to observe behaviors and postulate what underlies them.

Task

Music can be a particularly rich domain for illuminating elements of cognition (Bamberger, 1979, 1992) and learning to sing a song is a universally shared experience. The song chosen for the study was a Zulu song, not familiar to any of the participants. Because the song was quite complex, it could not be learned in a single hearing and the children had to employ strategies in order to learn it (Brown & DeLoache, 1978; Siegler, 1986).

We aimed at identifying these strategies, and the ways children organized the sounds they heard into meaningful musical entities. We claim that these strategies and these components of musical organization are the proposed Mental Model, i.e., the psychological entity that underlies children's observed behaviors in this study.

Participants in the Study

36 children in three age groups participated in the study - 6-, 9- and 12-year-olds. In each group, half of the children were learning to play a musical instrument. They were not experts (Berliner, 1987), but they were more experienced learners than children who do not play an instrument.

Procedure

The children were tested individually. They were provided with a tape and audio-cassette, a recording of the song, a xylophone, a small drum, pens and paper and asked to do anything they liked in order to learn the song. They were also told that the experimenter knew the song and could be asked about it.

Each child was recorded on video- and audiotape while learning. Every rendering of the song where the child sang without the tape was transcribed and the videos and transcriptions were carefully examined and described, as shown in the following example.

Example

1. Description of Observed Behaviors

The child listens to the complete song a number of times and then tries to sing it. He says the words are difficult. He begins to write, listening to just one phrase at a time, stopping the tape, writing the words and adding "x 2" for phrases that are repeated.

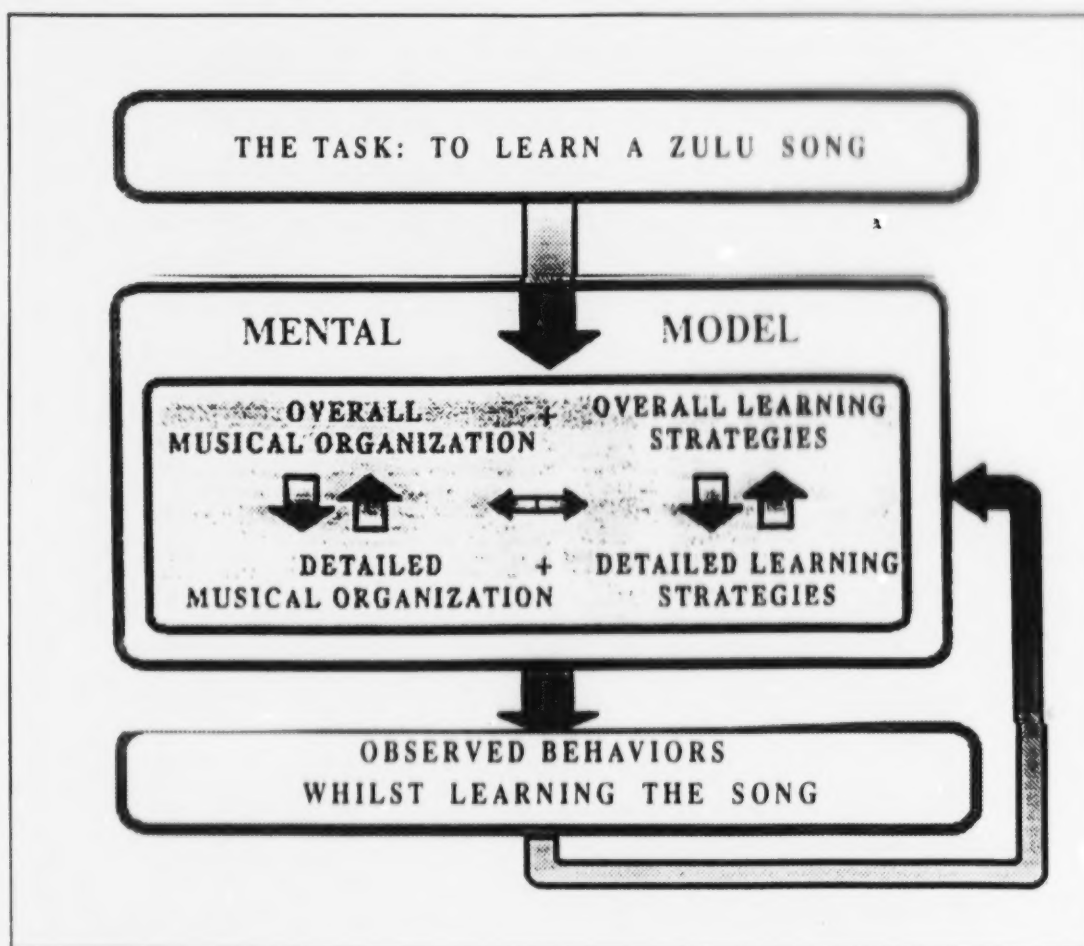
2. Interpretation: Strategies and Musical Organization which underlie the Observed Behaviors

The child begins by **evaluating** his progress (overall learning strategy) and **planning** what to do next (detailed learning strategy). He is **simplifying** the task (overall learning strategy) by **dividing** the song **into parts** (detailed learning strategy) and he is **preserving** his knowledge (overall learning strategy) by **using visual symbols** (detailed learning strategy). He recognizes the **borders between sections and repetition** of some parts (overall musical organization) and writes "x 2" to show the **structure** of the song (detailed musical organization).

Diagram 1 shows the relationship between the task, the categories which make up the Mental Model (strategies and musical organization, each at two levels) and observed behaviors.

Diagram 1

Relationships Between the Task, the Mental Model and Observed Behaviors



Summary of Results

1. The Mental Model is made up of the strategies which children employed and the ways in which musical stimuli were organized into meaningful entities, each category at two levels: an overall level and a detailed level. We found 7 overall learning strategies, 18 detailed learning strategies, 8 components of overall musical organization and 21 components of detailed musical organization. The order of occurrence of the strategies and components is shown in Table 1. In all age groups, the strategies

Table 1

Categories and Components of the Mental Model Showing Order of Occurrence of the Components

Overall musical organization • familiar/unfamiliar (words, style) • sections (boundaries) • text-music relationship • symmetry • repetition/change (content) • flow, motion • stability/instability • configuration of the whole song	Overall learning strategies • collecting information • creating a framework • preserving • evaluating • simplifying • generalizing • refining (fine tuning)generalizing
Detailed musical organization • words of song • rhythmic motives • beat, pulse • tempo • accents • general contour of parts of the song • plausible endings • opening motive • rhythmic continuity • balanced sections • moving away and coming back • complete structure • local tonality • overall tonality • distinctive melodic motives • structural pitches • absolute starting pitch • general contour of the whole song • contrasting motive • reduced structure • accurate pitches of the whole song	Detailed learning strategies • paying attention to relevant stimuli • verbalizing • planning • asking questions • assessing • asking for feedback (verbal and non-verbal) • associating • anticipating/tesing intuition • matching to the source • getting it out to work on it • learning part by part • testing intuitions • using visual symbols • doing it again, repeating • working on a particular component • trying to remember (using inner hearing) • slowing it down • asking for demonstration/assistance

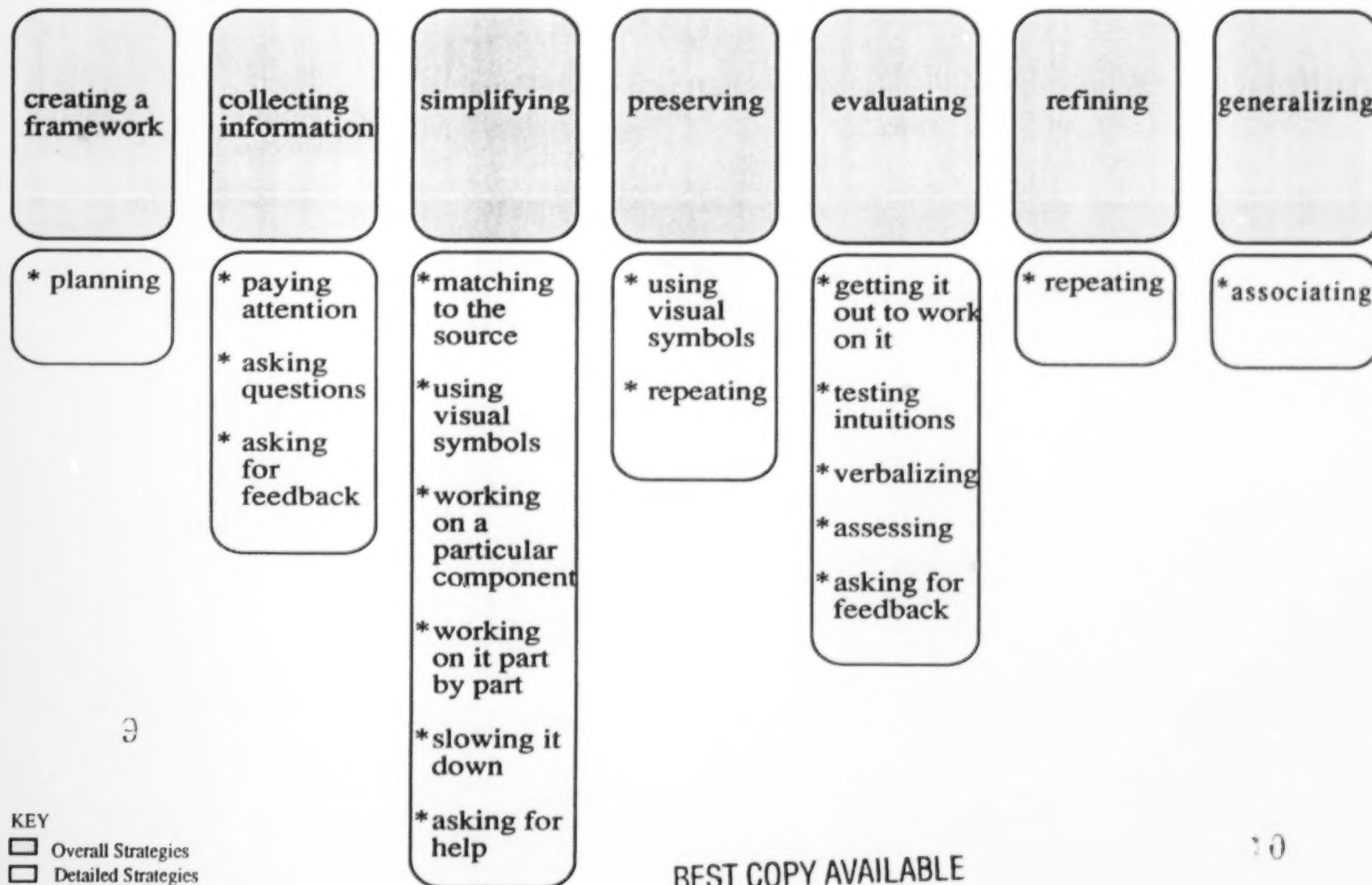
2. The components may be called a Mental Model because they are interrelated (Johnson-Laird, 1983; Norman, 1983). There are relationships between three levels of observed behaviors, between the parts of the Mental Model, and between the observed behaviors and the Mental Model (Appendix E). The relationship between the parts of the Mental Model, i.e. between the overall learning strategies and the detailed learning strategies, and between the components of overall musical organization and detailed musical organization, are shown in Diagrams 2 and 3.
3. The results showed a significant developmental pattern: younger children were less accurate in singing the song, required more time to learn it, used more strategies in the process and used less components of musical organization. Older children achieved a higher level of accuracy in less time. They used less learning strategies but they used more components of musical organization. This is shown in Appendices A - D.
4. Children who played an instrument learned the song in less time and used less learning strategies in the process than children who did not play an instrument, but there was no significant difference between these two groups for the number of components of musical organization expressed in their renditions of the song.
5. The children in all groups demonstrated an understanding of functional musical coherence and use of cultural idioms, even when their actual renditions of the song were inaccurate.
This is shown by:
 - use of plausible endings (which were not necessarily accurate)
 - over emphasis of tonic
 - over emphasis of structural tones
 - leaving out repetitions
 - awareness of open-closed: moving away and back from the tonal center in various ways
 - overemphasis of return to familiar e.g. A-B-A instead of A-A-B-B (ab-ab-cb'-cb').
 - creation of sequences which change melodic contour.

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Diagram 2

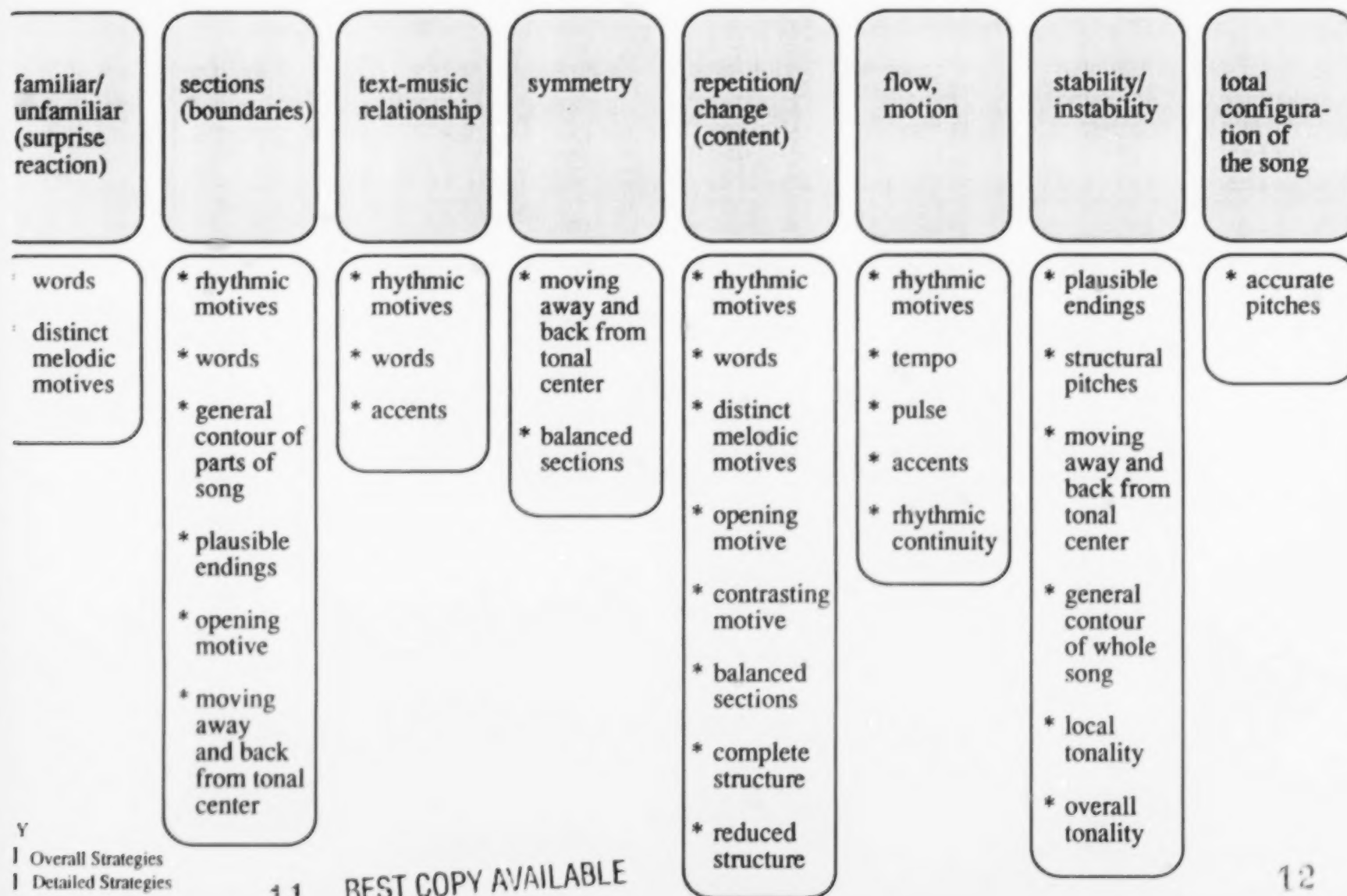
Relationship Showing Overall Learning Strategies and Detailed Learning Strategies



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Diagram 3

Relationship Showing Components of Overall Musical Organization and Components of Detailed Musical Organization



Y
I Overall Strategies
I Detailed Strategies

APPENDIX A

Use of Learning Strategies and Meaningful Musical Organization for Three Age Groups when Learning a Song

	6-year-olds	9-year-olds	12-year-olds
Number of overall learning strategies	1079	900	725 *
Number of detailed learning strategies	1373	1022	789 *
Number of overall musical organization components	48	66	80 *
Number of detailed musical organization components	120	172	218 *

* significant at a level of $p < .001$

Appendix A shows that the developmental relationship between learning strategies and meaningful musical organization operates in opposite directions. In other words, as the number of learning strategies used decreases, so the number of components related to musical organization increases.

APPENDIX B

Use of Learning Strategies and Meaningful Musical Organization for Six Groups by Age and Instrument Training

	6 - n **	6-y ***	9 - n	9 - y	12 - n	12 - y
Number of overall learning strategies	662	417	577	323	410	315 *
Number of detailed learning strategies	811	562	640	382	458	331 *
Number of overall musical organiz. components	28	20	31	35	41	39 *
Number of detailed musical organization components	67	53	74	98	114	104 *

* significant at a level of $p < .001$

** n = children who do not play an instrument

*** y = children who play an instrument

APPENDIX C

Total time (in seconds) Spent Learning the Song and Level of Accuracy Achieved for the Three Age Groups

Age in years	Levels of Accuracy when Singing the Song					Total Time Spent (in seconds) *
	Accurate.	Near acc..	Medioce.	Inaccurate.	Did not sing.	
6-yr-olds	-	6	2	2	2	16303
9-yr-olds	4	3	2	1	2	9988
12-yr-olds	3	5	3	1	-	7796

* significant at a level of $p = .01 <$

Linear term significant at a level of $p = .001$

APPENDIX D

Total time (in seconds) spent learning the song and level of accuracy achieved for six groups by age and instrument training

Age in years	Levels of Accuracy when Singing the Song					Total Time Spent (in seconds) *
	Accurate	Near acc. .	Mediocre.	Inaccurate.	Did not sing	
6-no**	-	4	1	-	1	8451
6-yes***	-	2	1	2	1	7852
9-no	3	1	1	1	-	6350
9-yes	1	2	1	-	2	3638
12-no	1	3	1	1	-	4438
12-yes	2	2	2	-	-	3358

* significant at a level of $p = .01 <$

Linear term significant at a level of $p = .001$

** no = children who do not play an instrument

*** yes = children who play an instrument

APPENDIX E

In order to claim that the psychological entity described is a Mental Model, the coded material should satisfy three criteria:

1. A relationship should be found between the categories of the observed behaviors upon which the Mental Model is based, i.e. the observed behaviors should be structured and not random.
2. A relationship should exist between the parts of the Mental Model. In other words, the Model is not merely a list of components.
3. There should be a relationship between the observed behaviors and the Mental Model.

First Criterion:

Relations among Observed Behaviors

The relationships between these three levels of observed behaviors were tested by statistical analysis.

Two analyses were carried out, and both were statistically significant. We found significant relationships between phases and activities:

($\chi^2 = 9907.6$, $df = 45$, $p < .001$)

and between activities and actions

($\chi^2 = 4937.2$, $df = 189$, $p < .001$).

These results show clearly that the observed behaviors upon which the coding of the proposed Mental Model was based, are related to each other. This satisfies the first criterion for claiming the existence of a Mental Model.

Second Criterion:

Relationship between the parts of the Mental Model

Correlation coefficients between the overall learning strategies and detailed learning strategies, and between the components of the overall musical organization and of the detailed musical organization were significant at the level of $p < .01$.

This confirmed the hypothesized relationships between the two levels of learning strategies and between the two levels of musical organization.

These results satisfy the second criterion for claiming the existence of a Mental Model.

Third Criterion:

Relationship between the Observed Behaviors and the Mental Model

Correlation coefficients show that the relationship between most of the components of the observed behaviors and the components of the proposed Mental Model were significant at a level of $p < .01$.

This satisfies the third criteria for claiming the existence of a Mental Model.

Confirmation of the Existence of a Mental Model

All three of the above criteria have been met. It is therefore possible to claim that the psychological entity that underlies the behaviors in this study is our model of the Mental Model children have of their own learning, as derived from learning a song.